

**SWITCHING DEVICE****BACKGROUND OF THE INVENTION**

**[0001]** The invention relates to switching devices according to the preamble of claim 1.

**[0002]** Switching devices are instruments employed for opening and closing an electric circuit. The switching device comprises at least one pole and a control device adapted to open and close said pole. Switching devices include switches and switch-fuses, for example.

**[0003]** A switching device of a known type comprises a control shaft and a working shaft installed in a frame part, the control shaft being rotatable and adapted to turn the working shaft, which, in turn, is adapted to change the position of the poles of the switching device. The control shaft of such a switching device is typically substantially transverse relative to the working shaft.

**[0004]** The problem in the above-described arrangement is that limiter means have to be provided in the frame part of the switching device for limiting the rotational angle of the control shaft and/or the working shaft.

**BRIEF DESCRIPTION OF THE INVENTION**

**[0005]** The object of the invention is to provide a switching device allowing the above-mentioned problems to be solved. The object of the invention is achieved with a switching device, which is characterized in what is stated in the independent claims. Preferred embodiments of the invention are described in the dependent claims.

**[0006]** The invention is based on designing and placing the working shaft and the control shaft of a switching device such that one of them passes through the other.

**[0007]** An advantage of the switching device of the invention is that no separate limiter means for limiting the rotational angle of the control shaft or the working shaft have to be provided in the frame part. In addition, in certain kind of assemblies, the structure of the switching device of the invention is advantageous as regards the use of space. Furthermore, in certain cases, the invention simplifies the structure of the switching device assembly.

**BRIEF DESCRIPTION OF THE FIGURES**

**[0008]** In the following, the invention will be described in more detail in connection with preferred embodiments with reference to the accompanying

drawings, in which

Figure 1 Figure 1 shows the control device module of a switching device according to an embodiment of the invention seen obliquely from above;

Figure 2 shows the control device module of Figure 1 seen obliquely from below;

Figure 3a shows a shaft element of the control device module of Figure 1; and

Figure 3b shows a control shaft of the control device module of Figure 1.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0009]** A switching device according to an embodiment of the invention is composed of a control device module and pole cell modules (not shown) connected thereto according to Figure 1. A working shaft 3 and a control shaft 4 are installed in a frame part 2 of the control device module, the control shaft being rotatable and adapted to turn the working shaft, and the working shaft 3 being adapted to change the position of the poles of the switching device. A shaft element 6 in the control device module constitutes part of the working shaft 3 of the switching device. Figure 2 shows that the control shaft 4 extends substantially through the frame 2 of the control device module, and that the control shaft 4 can also be accessed from the bottom of the frame 2 of the control device module.

**[0010]** Figure 3a shows a shaft element 6 detached from the control device module of Figure 1. The shaft element 6 comprises a first end 10, a second end 12 and two crossbars 14 interconnecting said first and second end. A gap remains between the crossbars 14 and it passes via the axis of revolution of the shaft element 6. The crossbars 14 are shaped and placed such that, seen from the axial direction, the distance between the crossbars 14 is about 180° on the first side, and about 90° on the other side.

**[0011]** The second end 12 of the shaft element 6 is thicker than the first end 10. The crossbars 14 are connected substantially to the periphery of the first 10 and second 12 ends. On the larger part of the stretch between the ends 10 and 12 of the shaft element 6 the distance between the crossbars 14 substantially corresponds to the diameter of the second end 12 of the shaft element 6. The bends of the crossbars 14, intended to change the distance

between the crossbars to correspond substantially to the diameter of the first end 10 of the shaft element 6, are provided adjacent to the first end 10.

**[0012]** The shaft element 6 is adapted such that it is able to transfer the power required for opening and closing the poles of the switching device in the direction of both its first end 10 and its second end 12. Accordingly, pole cell modules can be installed in the first end 10 and/or the second end 12 of the shaft element 6.

**[0013]** The shaft element 6 is provided with a peg 16 adapted to turn the shaft element 6. The peg 16 is located adjacent to the first end 10 of the shaft element 6. The shaft element 6 is installed in the frame part 2 such that the peg 16 faces the lower part of the frame part 2.

**[0014]** Both crossbars 14 of the shaft element 6 are provided with a shoulder 18. The shoulders 18 are adapted to limit the turning of the control shaft 4. The first shoulder is adapted to limit the clockwise turning of the control shaft 4. This shoulder allows the control shaft to turn 90° clockwise relative to the basic position of the control shaft, whereby the control shaft is in a position corresponding to the I position of the switching device. The second shoulder is adapted to limit the anticlockwise turning of the control shaft 4. This shoulder allows the control shaft to turn 45° anticlockwise relative to the basic position of the control shaft, whereby the control shaft is in a position corresponding to the testing position of the switching device.

**[0015]** Figure 3b shows a control shaft 4 detached from the control device module of Figure 1. In the control device module of Figure 1, the control shaft 4 passes between the crossbars 14 of the shaft element 6 through the shaft element such that the axes of rotation of the working shaft 3 and the control shaft 4 intercept at a substantially 90° angle.

**[0016]** In some alternative embodiments, the axes of rotation of the working shaft and the control shaft do not intercept, but, however, the working shaft and control shaft are at an angle relative to one another. Herein, shafts that are at an angle relative to one another refer to shafts that are not parallel.

**[0017]** Tooth means 20 are provided in the control shaft 4 and they are adapted to drive auxiliary contacts (not shown). The tooth means 20 also comprise a limiter tooth 22, which is adapted to cooperate with the shoulder 18 of the crossbar 14 for limiting the rotation of the control shaft 4. The limiter tooth 22 is longer in the axial direction of the control shaft 4 than the other teeth of the tooth means 20.

**[0018]** Figure 3b also shows a cam element 24 installed in the lower end of the control shaft 4 and adapted to cooperate with the peg 16 of the shaft element for turning the shaft element 6.

**[0019]** The shaft element 6 is installed in the frame part 2 such that said smaller opening (about 90°) between the crossbars 14 faces the lower part of the frame part 2, said larger opening (about 180°) facing the upper part of the frame part 2. The smaller of said openings limits the rotation of the shaft element 6 such that in each extreme position, the corresponding crossbar 14 hits the control shaft 4 thus preventing the shaft element 6 from rotating any farther.

**[0020]** It is to be noted that the angle between the extreme positions of the shaft element 6 is substantially smaller than the opening between the crossbars 14. This results from the radial dimension of the control shaft 4. The swing angle of the shaft element 6 is dimensioned in a manner allowing the controllable poles of the switching device to be shifted reliably from one position to another. In the embodiment shown in the figures, the thickness of the control shaft 4 is dimensioned such that the angle between the extreme positions of the shaft element 6 is about 35°. An about 90° rotational angle of the control shaft 4 corresponds to the extreme positions of the shaft element 6.

**[0021]** In the control device module according to the above-described embodiment, the control shaft 4 is adapted to limit the rotation of the shaft element 6, and the shaft element 6 is adapted to limit the rotation of the control shaft 4, and therefore no separate limiter means for limiting the rotational angle of the control shaft 4 or the shaft element 6 are required. The fact that no separate limiter means are required simplifies the structure of the control device module and saves space inside the frame part 2. The frame part 2 of a control device module of the above-described type can be made from a softer material than the control shaft 4 and the shaft element 6, since the frame part 2 does not have to serve as a rotation limiter.

**[0022]** The control shaft 4 of a switching device according to a preferred embodiment of the invention is a pipe shaft, i.e. it is hollow inside. A hole substantially of the shape of e.g. a square can be provided through the control shaft 4 in the axial direction, such a hole being provided in the control shaft 4 shown in the figures.

**[0023]** A control shaft 4 of the pipe shaft type can be turned with an inner shaft (not shown) insertable into the control shaft 4. The distance of an

actuator, such as an operating handle, from the frame part 2 of the control device can be easily adjusted by gliding the inner shaft in the axial direction relative to the control shaft 4.

**[0024]** When two control device modules provided with a tubular control shaft 4 are placed coaxially relative to the control shafts 4, the control shaft 4 of both control device modules can be turned with one sufficiently long inner shaft, which is inserted into the control shaft 4 of both modules. In this case, at least one of said two modules has to be such that its control shaft 4 can be accessed from both its axial ends.

**[0025]** Placing two control device modules provided with a tubular control shaft 4 back to back allows a control device for a throw-over switch, for example, to be provided. Such a control device can be of the type I – 0 – II, in which case the turning of the control shaft from the zero position in a first direction closes the first poles, and the turning of the control shaft from the zero position in a second direction closes the second poles.

**[0026]** In case control device modules, each comprising a shaft element 6 of Figure 3a and a control shaft 4 of Figure 3b, are employed in a throw-over switch of the type I – 0 – II described above, one shoulder 18 has to be removed from the shaft element 6 of both modules. The shoulder to be removed is the one allowing the control shaft to turn only 45° anticlockwise relative to the basic position of the control shaft. In this case, the control shaft 4 is able to turn 90° anticlockwise relative to the basic position of the control shaft, whereby the control shaft of the control device module coupled back to back with said module reaches its I position. In such a throw-over switch, the turning of the interconnected control shafts 4 in the first direction is limited by the remaining shoulder of the first module, and the turning in the second direction is limited by the remaining shoulder of the second module.

**[0027]** Alternatively, the control shafts of two adjacent control device modules can also be interconnected by means of connecting elements provided at the ends of said control shafts.

**[0028]** In a switching device according to the above-described embodiment, the control shaft 4 passes through the working shaft 3. It is also feasible to provide a switching device according to the invention, where the working shaft passes through the control shaft.

**[0029]** The structure of the invention wherein one shaft of the switching device passes through another shaft was described above in con-

nection with a modular switching device. However, it is evident that, if desired, the structure of the invention can also be used in a switching device wherein the control equipment is placed in the same frame part as the poles of the switch.

**[0030]** It is obvious to a person skilled in the art that the basic idea of the invention can be implemented in a variety of ways. Consequently, the invention and its embodiments are not restricted to the above examples, but may vary within the scope of the claims.

## CLAIMS

1. A switching device comprising a working shaft (3) and a control shaft (4) installed in a frame part (2), the control shaft being rotatable and adapted to turn the working shaft, and the working shaft (3) being adapted to change the position of poles of the switching device, **characterized** in that one (4) of said two shafts (3, 4) passes through the other (3), and that said shafts (3, 4) are at an angle relative to one another.

2. A switching device as claimed in claim 1, **characterized** in that the control shaft (4) passes through the working shaft (3).

3. A switching device as claimed in claim 1 or 2, **characterized** in that the axes of rotation of the working shaft (3) and the control shaft (4) intercept.

4. A switching device as claimed in claim 3, **characterized** in that the angle at which the axes of rotation of the working shaft (3) and the control shaft (4) intercept is substantially 90°.

5. A switching device as claimed in any one of the preceding claims, **characterized** in that the working shaft (3) and the control shaft (4) are shaped in such a manner that they limit each other's rotational angles to desired values.

6. A switching device as claimed in any one of the preceding claims, **characterized** in that the control shaft (4) is rotatable from either axial end.

7. A switching device as claimed in claim 6, **characterized** in that its control shaft (4) is adapted to be connected to a control shaft (4) of another similar type of switching device in a manner allowing the working shafts (3) of both switching device to be turned by rotating the control shaft (4) of one or the other switching device.

8. A switching device as claimed in claim 7, **characterized** in that the control shaft (4) is a pipe shaft, and in that the control shaft (4) is adapted to be connected to a control shaft (4) of another similar type of switching device by means of an inner shaft insertable into the control shafts.

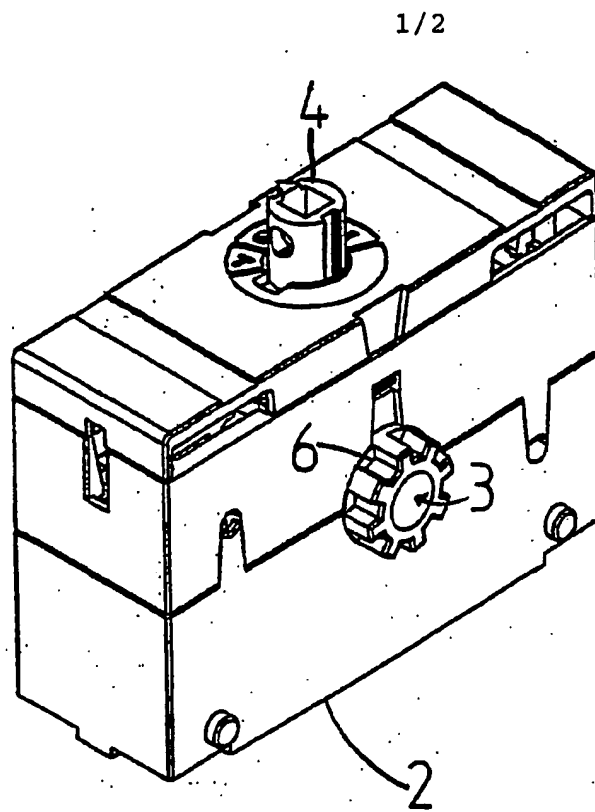


FIG 1

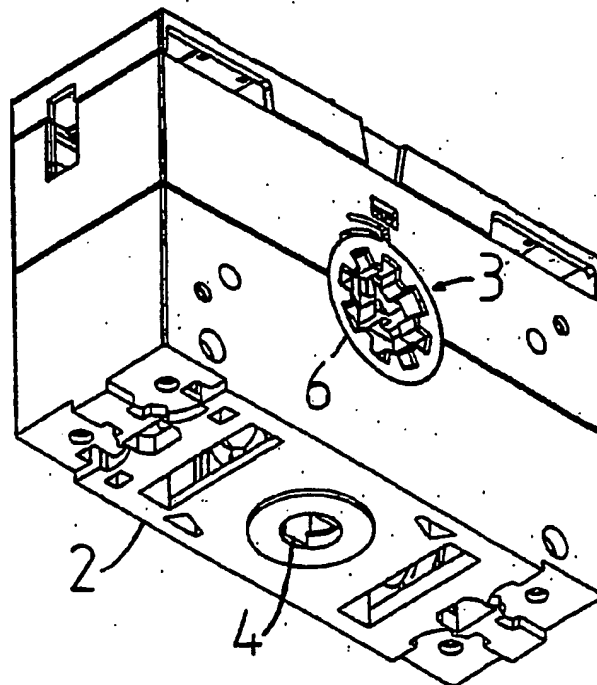
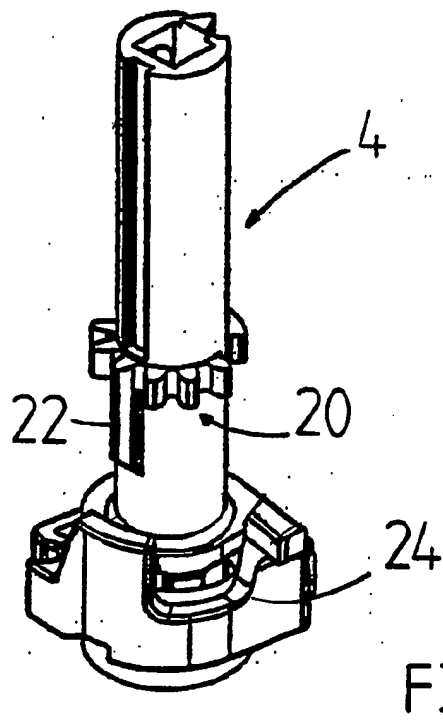
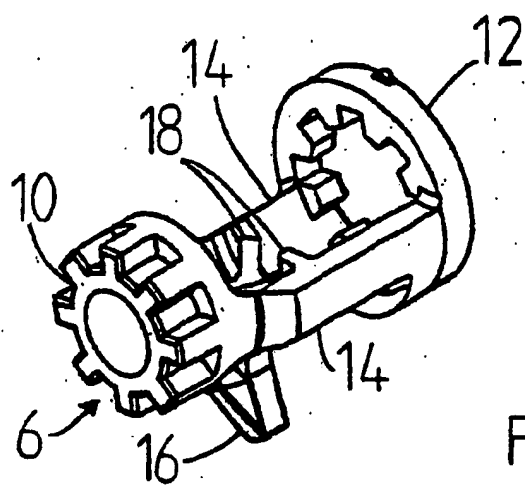


FIG 2





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 2005/000031

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01H 9/00, H01H 19/60

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4218594 A (KOMATSU, H. ET AL), 19 August 1980 (19.08.1980), column 1, line 11 - column 4, line 36  --	1-8
A	PATENT ABSTRACTS OF JAPAN Vol. 2000, No. 12, 03 January 2001 (2001-01-03) abstract & JP 2000 243189 A (TAKAOKA ELECTRIC MFG CO LTD) 08 September 2000 (2000-09-08)  --	1-8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

17 May 2005

Date of mailing of the international search report

19-05-2005

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 2005/000031

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN Vol. 1997, No. 06, 30 June 1997 (1997-06-30) abstract & JP 09 050740 A (MITSUBISHI ELECTRIC CORP) 18 February 1997 (1997-02-18)  --	1-8
A	US 6317019 B1 (HERPIN, J-P. ET AL), 13 November 2001 (13.11.2001), column 1, line 8 - column 4, line 7  --	1-8
A	US 5777283 A (GREER, D.E.), 7 July 1998 (07.07.1998), column 1, line 47 - column 5, line 4  -- -----	1-8

## INTERNATIONAL SEARCH REPORT

Information on patent family members

01/04/2005

International application No.

PCT/FI 2005/000031

US	4218594	A	19/08/1980	JP	54024076	U	16/02/1979
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US	6317019	B1	13/11/2001	AT	247863	T	15/09/2003
				AU	741762	B	06/12/2001
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				WO	0045768	A	10/08/2000
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US	5777283	A	07/07/1998	US	5609245	A	11/03/1997
				US	5737195	A	07/04/1998
				US	5739488	A	14/04/1998
				US	5746306	A	05/05/1998
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# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

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P.O. Box 148  
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## PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing (day/month/year)	19-05-2005
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Applicant's or agent's file reference  
2032410PC/ko

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/FI 2005/000031

International filing date (day/month/year)  
18.01.2005

Priority date (day/month/year)  
19.01.2004

International Patent Classification (IPC) or both national classification and IPC  
H01H 9/00, H01H 19/60

Applicant  
ABB OY et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

### 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further opinions, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/FI 2005/000031

Box No. I      Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.  
☐ This opinion has been established on the basis of a translation from the original language into the following language, \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material  
☐ a sequence listing  
☐ table(s) related to the sequence listing
  - b. format of material  
☐ in written format  
☐ in computer readable form
  - c. time of filing/furnishing  
☐ contained in the international application as filed.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/FI 2005/000031

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-8	YES
	Claims		NO
Inventive step (IS)	Claims	1-8	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-8	YES
	Claims		NO

2. Citations and explanations:

Documents cited in the International Search Report:

D1: US 4218594 A  
D2: JP 2000243189 A  
D3: JP 9050740 A  
D4: US 6317019 B1  
D5: US 5777283 A

The cited documents represent the general state of the art.

The invention defined in claims 1-8 is not disclosed by any of these documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed switching device. Therefore, the claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1-8 is novel and is considered to involve an inventive step. The invention is industrially applicable.